Collateral Regulation and IPO-Specific Liberalization: The Case of Price Limits in the Athens Stock Exchange[1]

Stavros Thomadakis, Dimitrios Gounopoulos, Christos Nounis, Andreas Merikas

European Financial Management, Forthcoming

Abstract

This paper uses a unique testing ground on the effect of price limits upon IPO pricing and initial returns. The Athens Stock Exchange offers the opportunity for this new experiment, as three substantial changes in limit regulations were implemented in a short period of eight years. The results indicate significant differences in initial returns. Effective price limits reduce underpricing in all market segments, without visible diminution of IPO activity. The introduction of mandatory book-building after price limits were phased out in Athens also led to reduced underpricing in the main market segment. Nevertheless, the existence of an independent effect of price limits explains why some regulators continue to use them to the present day.

Keywords: Price Limits; IPO Underpricing; IPO Regulation; Government Intervention; Hot/Cold Market Conditions.

JEL classification: G14, G32, G24

[1]Stavros Thomadakis is from University of Athens, School of Economics, Athens, Greece, E-mail: thomadakis@econ.uoa.gr. Dimitrios Gounopoulos is from School of Business Management and Economics, University of Sussex, Falmer, Brighton, UK, E-mail: d.gounopoulos@sussex.ac.uk. Christos Nounis is from University of Athens, School of Economics, Athens, Greece, E-mail: *cnounis@econ.uoa.gr*. Andreas Merikas is from University of Piraeus, Department of Maritime Studies, Piraeus, Athens , Greece, Email: merikas@otenet.gr. We gratefully acknowledge Cecile Carpenter, Thomas Chemmanur, Elroy Dimson, John Doukas (The Editor), Tim Jenkinson, Conul Golak, Antonis Kallias, Kostadinos Kallias, Mario Levis, Jay Ritter, Silvio Vismara, two anonymous referees and seminar participants at the Vrije University of Amsterdam, the University of Athens and the University of Sussex for useful comments and suggestions. We would like to thank participants of the European Finance Association, European Financial Management Association and the Financial Management Association for helpful comments on earlier versions of this paper. Correspondence: Dimitrios Gounopoulos

1. Introduction

The regulation of IPOs has a long history around the world and is linked to intrinsic informational asymmetries that surround new listings [Chan et al. (2004), Chambers and Dimson (2009), Carpentier et al. (2012), Ekkayokkaya and Pegniti (2012), Burhop et al. (2014)]. Regulatory objectives regarding IPOs have sought the twin goals of financial regulation: efficient pricing and investor protection [IOSCO 2010]. These goals have been pursued with a variety of instruments. Disclosure requirements, audit regulation, contractual obligations of issuers and underwriters, arrangements (including constraints) for IPO pricing, price guarantees, overallotment options and trading restrictions for the after-market represent the wide range of regulatory interventions across developed and emerging markets.

As we would expect, the sophistication and timing of regulatory tools appear to vary with the degree of market development, the sophistication of market agents and market conditions. Regulatory techniques first introduced in developed markets, (viz. disclosure requirements, audit regulation or book-building), have been emulated in emerging markets in the process of their development. Regulatory interventions have been subjected to empirical tests which seek to clarify their effectiveness. These tests are based on diverse theoretical views about the desirability of regulation and the power of markets to self-regulate, to which we return below.

In this paper we focus on price limits. These have been a controversial subject and their empirical evaluation has been tested on the question of whether they affect price volatility. Here we pose a different and simple question: do price limits in the after-market have any effect on the well-established market inefficiency that is IPO underpricing? This simple question has not been asked before. But it is a reasonable question. In both theory and practice, early aftermarket conditions are important to those who make IPO pricing decisions. The answer to this question may inform regulatory decisions beyond what existing empirical evidence has already provided.

The occasion for asking this simple question is an enticing empirical opportunity presented by changes in Greek regulatory arrangements in the 1990s, a time when the Greek market experienced considerable development. General daily limits on price variation were imposed for the first time in 1992 and lasted until the end of the decade. Although directed to market stability in general, price limits had collateral consequences for the early IPO aftermarket. Recognizing this, regulators later decided that policy towards IPOs should change and price limits were relaxed specifically for early trading of IPO stocks in late 1996. This policy change allows us to test an area that has not been much examined in other empirical literature on IPO regulation: the impact of price limits on underpricing in conditions closely resembling a controlled experiment.

As we explain in the body of the paper, the impact of price limits on early trading of IPO stocks and the implications of the removal of these limits show, based on the Greek experiment, the occurrence of two synchronous effects: on one hand, the imposition of limits appears to reduce overall underpricing but, on the other hand, it also delays and complicates early price adjustment. We argue that these effects correspond to received theoretical reasoning and correlated empirical findings from various markets and times. In a broad sense, the explanation of variation in IPO underpricing across markets and times cannot be oblivious to regulatory interventions, as several authors have argued [Loughran, Ritter and Ryndqvist (1994)]. Furthermore, regulatory intervention itself must be evaluated in search for policy implications, as regulators continue to seek effective tools whenever they perceive market malfunction or failure.

Looking more specifically at after-market arrangements for newly listed stocks, we note that non-discretionary trading limitations such as price limits, trading halts or circuit-breakers continue to be used in many markets, especially emerging ones. For example, as recently as January 2012, SEBI, the Indian market regulator, imposed restrictive daily price limits for first-day trading of IPO shares, attempting to ‘prevent IPO manipulation’, in one of the largest emerging markets. Is this persistence of price limits warranted?

Price limits on stock market variation are a controversial subject both among practitioners and scholars. The central issue is the speed and efficiency of price discovery. Different lines of argument have been formulated about the impact of price limits on the quality of price adjustment. One side argues that limits are inefficient because they suppress rapid price discovery after an information shock [Fama and French (1989)]. A contrary line suggests that limits offer opportunities for "cooling down" of investor sentiment in an environment of information asymmetry, and thus allow for smoother price adjustment [Hanley (1993), Chowdhry and Nanda (1998), Loughran and Ritter (2002), Thomadakis et al. (2012)]. Both these views, which we can summarize as the competing 'information' and 'overreaction' hypotheses, are concerned with price shocks due to varying intensities and degrees of asymmetry of information. A considerable amount of empirical work has attempted to distinguish between these competing hypotheses. The impact of limits on volatility, serial correlation and price reversals has been studied with mixed results. The two competing views – the 'information' and the 'overreaction' hypotheses - lead to opposing regulatory implications about the desirability of limits.

An interesting variant of thinking relates to price change that is rooted not in pure information shocks but in a different source of disturbance: market manipulation. According to this view, the basic regulatory rationale for imposing price limits is to constrain the potential for manipulation by market participants who have the means to conduct manipulative schemes, [Kim and Park (2010)]. This rationale seems to us to be very pertinent to newly issued shares where asymmetries of information are more intense and the potential for manipulation is larger, especially in emerging markets where weaker competition and lack of contractual and investor sophistication weaken market-based deterrence to manipulation.

In the extensive literature on underpricing of IPOs, the effect of regulatory interventions has been examined, although not price limits, specifically. An example of this approach is the 'regulatory overreach hypothesis' relating to the effects of the Sarbanes-Oxley act on US IPO

activity [Gao, Ritter and Zhu (2013)]. Arguing that Sarbanes-Oxley improves transparency of primary offerings, Johnston and Madura (2009) present evidence that IPO underpricing in the US has declined after implementation of the act.

The Greek market in the 1990s, on which we focus, was classified as an 'emerging market', despite its participation in the European Union and its alignment to European legal arrangements. We have therefore paid special attention to tests of regulatory effects in emerging markets. Based on evidence from the Pacific Region, Loughran, Ritter and Rydqvist (1994) have advanced the conjecture that regulatory intervention appears to increase underpricing and distort market function. In line with this, evidence from the important process of market liberalization in China has also furnished clear signs that early overregulation caused very high underpricing which abated as regulations were phased out (Cheung et al. (2009)).

These approaches can be used as prima-facie arguments against any regulatory intervention, but in our opinion more careful reading of the evidence implies that it is not regulation in general but specific devices of intervention that may or may not be effective in bringing about desirable goals. Empirical investigations of regulation, in any case, do not focus primarily on price limits but involve more complex interventions. Price limits as a specific instrument can be separately evaluated only when they constitute autonomous regulatory policy, allowing us to empirically isolate their effects on underpricing. The example of the Athens Stock Exchange offers this opportunity.

The debate on the value of regulation is very wide and extends from institutional theories (e.g LaPorta et. al. (1998), Shleifer (2005)) to empirical examinations in a variety of contexts (Healy and Palepu, (2001); Mulherin, (2007); Zingales, (2009), Bonardo et al. (2011)). Our work does not purport to offer a general evaluation of regulation in the sense of these broad works. Instead it offers a valid empirical approach to a specific regulatory issue: the effect of price limits on the underpricing of IPOs.

We study price limits as they were applied in a particular exchange and at a particular time. We are cognizant of the fact that the effect of any particular regulatory device, such as price limits, may be conditioned by the more general institutional and technical arrangements, as the broad theoretical studies we mentioned above suggest. Thus, they may not be necessarily appropriate for all markets and all institutional contexts.

In the Greek market itself, price limits on early trading of IPO shares are eventually removed and book-building was introduced as an alternative device. We show in the paper that this alternative also had an effect on lowering under-pricing, although a weaker one than the earlier price limits. Book-building however required a certain amount of development, sophistication and competition among institutional investors in order to work and these were not necessarily available in earlier times.

The use of regulatory tools may have a time-specific and development-specific nature. After all, it is well understood that regulations and market innovations co-evolve and influence each other. Our evidence in this paper is that price limits effectively reduced under-pricing in the Athens Stock Exchange in the 1990s. Therefore they can prove to be a useful instrument in the regulatory toolbox under similar circumstances elsewhere in emerging or newly-established markets.

In the balance of the paper we provide a review of relevant literature in section 2. In section 3 we discuss regulations and underwriting arrangements in the Athens Stock Exchange. In section 4 we present hypotheses, methodology and test variables. Section 5 includes empirical results and section 6 presents robustness checks. Section 7 offers discussion of results and section 8 concludes the paper.

2. Related Literature

The empirical literature on IPOs is extensive and international. Its most voluminous branch concerns short - term performance of newly listed shares. The tenor of findings is exemplified

by comparative studies such as Loughran, Ritter and Rydqvist (1994) and Gajewski and Gresse (2006). These studies establish that initial IPO underpricing and the appearance of positive excess returns in the short run is a generalized phenomenon around the world. However, the intensity of underpricing exhibits great variation across markets and times. Many factors, including regulation, have been examined to account for this variation. These relate to demand and investor sentiment, competitive supply, firm characteristics that proxy for uncertainty, and incentives of underwriters and owners. We draw on these extensive findings in section 4 below, in choosing control variables for our tests of underpricing in the Athens Stock Exchange.

The contribution of regulatory policies to the variation of underpricing does not figure prominently in the majority of studies. It is taken up however in both theoretical and empirical contexts of inquiry about the general impact of regulation on capital markets. Since it is broadly felt that asymmetry of information lies at the root of underpricing, as Rock (1986) originally argued, regulatory policies of mandatory disclosure are widely acknowledged. Beatty and Ritter (1986), Sherman and Titman (2002), Ekkayokkaya and Pegniti (2012) exemplify arguments on how better information quality can lead to reduced underpricing. In line with these arguments the quality of disclosure standards must remain a major concern of regulators.

Regulation however is not limited to disclosure requirements. Rules that embrace the pricing and allocation of new offers, aftermarket arrangements and constraints on issuers and underwriters comprise the regulatory toolbox in many cases. Regulations, as Leuz and Wysocki (2008) successfully argue, must function as a low-cost commitment device for preventing market failures. Arguments suggesting, as well as casting doubt, on the net benefit of capital market regulation abound, with largely mixed conclusions [Healy and Palepu (2001), Mulherin (2007), Shleifer (2005), Zingales (2009)]. From a policy standpoint, the position is also moot. In part this is due to factors that limit empirical measurement and testing of one or the other viewpoint. For

example, the emergence of institutional arrangements surrounding new-issue markets evolve frequently as a matter of contractual agreements among market participants and cannot be directly ascribed to mandatory regulations. Furthermore, the impact of regulatory interventions can be tested only when discrete changes in regulations occur. In practice, many regulations change in piecemeal fashion, following an evolutionary path that intermingles with market development. Thus, it is important to discover empirical conditions of discrete and well defined regulatory change that enable focused testing, as is the case we examine here.

The quest for appropriate regulation has been renewed in emerging markets, with empirical work over the last two decades. In the process of catch-up, many of these markets imported regulatory standards from advanced economies but also formulated regulations according to local brands of investor protection, perceptions of fairness or social welfare. These offered accordingly a new field of testing for the effectiveness of regulatory practices. This literature and the issue of appropriate regulation are of special relevance to the Greek case, since the ASE was classified as an emerging market in the 1990s and many new regulatory arrangements were inaugurated over that period.

In this strand of literature, Pettway and Kaneko (1996) in a Japanese study examined IPO underpricing before and after a change in regulation in the Tokyo Stock Exchange. They find that a relaxation of constraints which delayed the commencement of trading of newly listed shares led to less severe underpricing. Several studies have looked at the liberalization of the market in mainland China over the last decade. Tian (2011) observes that underpricing in Chinese IPOs is mainly caused by government intervention with IPO pricing regulations and the control of IPO supplies. Cheung et al. (2009) also document the impact of liberalization in China. They note that Chinese IPOs exhibit huge underpricing, which decreases over the period of liberalization and that, after adopting a series of regulatory reforms allowing underwriters discretion in the determination of issue price, this 'regulatory underpricing' component vanishes.

In a number of studies that address various aspects of national regulatory requirements across different Asian countries there are additional insights on the implications of institutional constraints for underpricing, such as Chen (1992) for Taiwan, Kao et al. (2009) and Tian (2011) for China, Ekkayokkaya and Pengniti (2012) for Thailand and Chang et al. (2012) for Korea. In the case of Korea, Chang et al. (2012) for example conclude that the high level of underpricing in Korean IPOs is the unintended consequence of regulations designed to promote fairness. Two aspects of the regulations distort the process - an "essential price" formula that severely understates the value of the firm and bid exclusion rules that give investors a strong incentive to cluster their bids so as to avoid being excluded from the offering.

An early study of the Athens Stock Exchange by Kazantzis and Levis (1995) looked at a different regulatory intervention that was in force from 1987 to December 1990. This was an obligation imposed on the underwriter to offer price support to IPO shares for six months after listing. They concluded that "…measures to intervene in the pricing process …result in excessive underpricing". Thomadakis et al. (2014) point out that IPOs in Greece remained unregulated prior the WWII period while the growth of the Greek stock market was coincident with development episodes in the economy, as well as phases of protectionism.

The conclusions of much of the empirical literature on direct regulatory interventions in emerging markets have been aptly summarized by Loughran, Ritter and Rydqvist (1994), who advance an enticing conjecture: regulatory intervention appears to distort market function and increase underpricing of IPOs. This conjecture is of course based on tests of regulatory policies that include a variety of measures in various countries. None of these however, have presented a direct test of price limits in the early after-market. Our Greek experiment will therefore extend the field over which the validity of this conjecture is tested.

Price limits and their effects on IPO underpricing have not been directly tested to our knowledge. However, the more general debate on the effectiveness of price limits for market operation has been an important and controversial one in finance. Theoretical and empirical

arguments have focused on the effect of price limits on volatility of returns and on their time behavior. Different lines of argument have been formulated on the general impact of price limits (or more generally 'circuit breakers'). One line proposes that limits are inefficient as they suppress rapid price discovery without reducing overall volatility, since any information shock is eventually reflected in the price [Fama and French (1989)]. A contrary line suggests that there is investor overreaction and that limits offer opportunities for 'cooling down' of investor sentiment, allowing for both smoother price adjustment and lower volatility [Chowdhry and Nanda (1998)]. An interesting variant of thinking is that the basic rationale for imposing price limits is the diminution of the potential for market manipulation by market participants who have the means to conduct manipulative schemes, [Kim and Park (2010)]. In principle the banishment of manipulation should also reduce volatility.

Many empirical studies of the effect of price limits have been conducted, again with emphasis in Asian emerging markets and again with mixed results, as surveyed for example in Kim and Yang (2004). The emphasis of these studies is the question of whether limits affect volatility, volatility spillovers and trading efficiencies. Kim and Yang (2009) have examined the effect of price limits on IPO trading in Taiwan. They have concluded that limits increase follow-up volatility and that they obstruct early price discovery. Their tests could not be applied to the underpricing question however, since they had no comparable data from observations with limits and observations without limits.

This type of inquiry has also been undertaken with respect to the Athens Stock Exchange. Phylaktis et al. (1999) examined the competing 'information' and 'overreaction' hypotheses by assessing the effects of price limits on volatility in the Athens Stock Exchange. They found strong support for the information hypothesis, which implies that price limits only slow down the process of adjustment and have no effect on stock volatility. More recently, Diacogiannis et al. (2005) test the Athens Stock Exchange for evidence of investor overreaction to price limits themselves. They show that price limits delay market adjustment to a news disturbance, through

the operation of delayed orders, and that prices react positively to 'limit hits' followed by market reversals. They argue that price limits do not resolve market irregularities, and suggest that their elimination beyond 1999 was a rational decision [Gao et al. (2013)]. This evidence implies that tests of the effect of price limits on the early IPO after-market must take into account, inter alia, the possible reaction to the 'event' of a given price reaching a limit on a given day of trading.

3. Regulatory Limits and Underwriting Arrangements in the Athens Stock Exchange

3.1 Changing Restrictions on Daily Price Variation

Until June 1992, price fluctuations in the Athens Stock Exchange were unconstrained for all shares. In July 1992 the Exchange imposed a limit of ± 8% on daily variation. The regulation did not single out IPO shares for special treatment but applied uniformly. Its motivation was to protect investors and the market from 'speculative attacks'. The context of this regulatory action was one of macroeconomic risks, exchange rate pressure and fears that the Greek market might experience a precipitous decline. As the circumstances changed in subsequent periods, the market started to rise, a healthy supply of IPOs appeared but the limits remained in force.

Regulatory intent, as we said, did not specifically single out newly listed stocks nor was there any explicit statement about the need for limits for them specifically. In that sense, the regulation of the IPO after-market was simply a collateral consequence of a more general policy. In any day a stock price could fluctuate within a range of ±8 percent. When it reached the limit, no more trading could take place on the same day, except at (or of course within) the limit range. The stock would start trading again on the next day, its starting price being the limit price of the previous day.

Almost four years later, on December 1st, 1996, regulatory policy focused on newly trading stocks, reflecting a concern of regulators about delays in price discovery. Prices of newly listed shares were allowed to fluctuate within a limit of ±99% for the first three days of trading

(from the fourth day on, the limit of ±8% continued to apply). The limit of ±99 percent did not have specific policy significance; it was simply the highest possible daily variation that the electronic system of the Exchange could accommodate at that time.

The regulation changed again on December 1st, 1999 when it became technically feasible to abolish the ±99 percent limit; thereafter, the price of a newly listed company was allowed to fluctuate freely during the first three days of trading.

The rationale for these liberalizations was to improve the speed of price discovery. The Stock Exchange and the Regulator (the Capital Market Commission) agreed that newly listed stocks, which were coming from both the main and the second-tier markets, needed unrestricted early trading, in order to achieve rapidly their short – term 'equilibrium' price. Thus, whereas the imposition of limits back in 1992 was general, their relaxation was specifically directed to IPOs. This creates conditions of a 'controlled experiment' for testing the impact of price limits on IPO pricing.

In Figure 1 we show a timeline of the changes in Greek regulations.

Please Insert Figure 1 About Here

During the period under examination (1990-2013) 351 IPOs were launched on the Greek market. The discrete changes in price limits allow a division of the sample into sub-periods:

(a) January 1, 1990 to 30th June 1992 (no limits)

(b) July 1, 1992 to 30th November 1996 (±8% price limits)

(c) December 1, 1996 to 30th November 1999 (±99% during the first three days of trading)

(d) December 1, 1999 to 31st December 2013 (no limits for the first three days of trading)

Throughout the period, listing requirements for the main market were more severe than for the parallel market. The main difference was one of size and required track record, as in most

cases of such market distinctions; parallel market admission in Greece was explicitly directed towards the facilitation of younger and less well established firms, hence also riskier ones, to enable them to raise capital directly on the Exchange.

3.2 The Greek Underwriting Environment

Underwriting of primary share offers has been practiced in Greece since the 1970s. In the 1990s banks and investment service firms, including exchange members, were licensed to provide underwriting services. The legal requirements for underwriting had been aligned to the relevant European directives since the mid-1980s and were renewed as European legislation itself evolved in the 1990s. Thus, for example, any firm offering underwriting services had to comply with capital adequacy requirements as specified in the European Investment Services Directive (93/22/EEC). The most important legal development with regard to underwriting in the 1990s was the passage of Law 2651 of 1998 which strengthened transparency requirements for IPOs, clarified the limits of underwriter liability and enabled the use of book-building as a method of pricing.

In fact, the majority of IPOs undertaken until the end of January 2000 were launched using a fixed price auction. Beginning on January 31 of 2000, book-building was mandated for all issues above the size of 25 billion drachmas. This mandated change was instituted after the price limits had been phased out for the first three trading days, and can be viewed as the adoption of a more sophisticated (and market friendly) instrument for regulating the offer price and the after-market for IPOs. Overallotment options (green shoes) were used only sporadically (in only 7 cases), mainly again for large issues. In our overall sample of 351 IPOs, book-building was used in 90 cases, which included especially placements directed to international institutional investors.

The underwriting market remained pretty concentrated in Greece during the period studied here. Five major banks handled about 65 percent of all IPOs in the period 1990-2013, each of them enjoying a market share between 10 and 15 percent. The remaining IPOs were

underwritten by a larger number of minor banks and investment firms. The distribution of underwriting business is shown in Appendix Table C. The high concentration of underwriting activity makes possible a clear distinction between 'reputable underwriters' (the five major banks) and 'inexperienced underwriters'. We pick up this distinction with a dummy variable which is described in the next section.

4. Hypothesis, Data and Methodology

4.1 *The Effect of Regulatory Price Limits: Simple Exposition and Hypotheses*

Consider the price limit and successive returns:

Letting,

CP(t) be the first unconstrained closing price on day t

OP be the offer price

u(t) be the percent underpricing on day t,

it follows that:

$$u(t) = \{CP(t) - OP\}/OP \qquad (1)$$

Denoting the expected value of underpricing when no limits are present by uF(1) and when limits are in force by uC(t), we wish to compare, ceteris paribus, underpricing in two different regimes:

$$uF(1) (> \text{ or } <) uC(t). \qquad (2)$$

The direction of the inequality in (2) describes the effect of the regulatory regime as expressed in the imposition or removal of daily price limits.

The null hypothesis is that regulation by price limit is irrelevant to the efficiency of IPO pricing [i.e. equality of the two sides in (2)]. In this case, underpricing is unchanged in the two

regimes but the establishment of an unconstrained (short-term equilibrium) price is simply delayed by the price limit.

There are theoretical grounds for a hypothesis of expanded inefficiency. Fama and French (1996) have argued that price limits, as they delay price discovery, will increase volatility. The impact of such an effect on observed underpricing in a sample of IPOs can be positive as underpriced issues become more volatile. In this case, the direction of the inequality in (2) will favor a larger uC(t). One specific way in which price limits may distort the market process is by inducing inefficient prices through an 'overreaction' whenever limits are actually reached during a trading day. In their study of price limits on the Athens Stock Exchange, Diakogiannis et.al. (2005) find strong evidence of over-reaction to the 'event' of a stock hitting the daily limit on any trading day. The implication of such overreaction for short-term IPO returns would be a manifestation of increased underpricing. In sum, price discovery delays and additional volatility or/and overreactions due to the operation of price limits would, under this theoretical approach, confirm the more general conjecture by Loughran, Ritter and Rydgvist (1994) that regulatory intervention increases underpricing by distorting the market process. This hypothesis of expanded inefficiency would imply that the direction of inequality (2) would be in favor of a larger uC(t).

A competing hypothesis can also be formulated, arguing that:

$$uF(1) > uC(t). \qquad (3)$$

This is a hypothesis of reduced inefficiency of IPO pricing and its gist is a very simple proposition. In line with most of the literature, underpricing is used strategically by underwriters and/or issuers to reap rents for themselves or favorite clients through early trading returns, [Ruud (1993), Cestau, Hanley and Hoberg (2012) and Dorsman and Gounopoulos (2013)]. Price limits restrict the opportunities for such rent-seeking behavior and the strategic use of underpricing. Hence, the imposition of price limits will moderate underpricing and bring offer prices closer to efficient levels.

General arguments on price limits that promote a 'cooling off' effect provide additional support to this contrary hypothesis. A significant strand of literature on short - term underpricing shows that early trading returns on newly listed shares are excessive and affected by early investor sentiment, [Baker and Wurgler [(2006), (2007)], Campbell et al. (2009)]. Furthermore, some theorists, notably Ljungquist et al. (2006) and Cornelli et al. (2006), have proposed that initial underpricing can be seen as a strategy on the part of issuers and underwriters to appropriate 'hot' investor sentiment, in the short-run. Baker and Wurgler (2006) argue that higher information asymmetry intensifies the appearance of investor sentiment. Campbell et al. (2009) offer empirical verification of this assertion for the case of IPO stocks.

If early investor sentiment, whether spontaneous or managed by underwriters, is responsible for underpricing (or some portion thereof), it is plausible that its manifestation will be hampered by limits on price variation. As a result, the attractiveness of underpriced issues to short-term investors will be tempered; In line with arguments presented in Boehme and Colak (2012) the clientele of IPO shares may then shift away from short-term speculators.

All in all, as the prospect of rapid price increases is reduced, issuers and underwriters will also have reduced incentives to underprice and offering prices will be closer to intrinsic values. The argument by Kim and Park (2010) presents an interesting extension to this thinking. They argue that the basic rationale for imposing price limits is the diminution of the potential for market manipulation by market participants who have the means to conduct manipulative schemes. This rationale has strong implications for newly listed shares where asymmetries of information are more intense, price history does not exist, supply is by definition managed and the potential for manipulation is therefore larger. But in this case, the opportunities for manipulation are mostly in the hands of underwriters and issuers who are the parties that decide IPO pricing.

The hypothesis we test with Greek IPO data focuses on the direction of inequality (2), and the two competing hypotheses we presented.

4.2 The Data on Greek IPOs

This study examines the initial performance of 351 IPOs listed in the Athens Stock Exchange (ASE) in the Main, Parallel and New boards during the period from January 1990 to December 2013. The sample contains only ordinary common stocks; it excludes the issue of preference stock as well as transfers from the Parallel to the Main market. The study extracts data mainly from IPO prospectuses, but also the daily press, ASE reports (History of ASE, Fact Books, Annual and Monthly Statistical Bulletins) and Annual Reports of the Hellenic Capital Market Commission (HCMC). The prospectuses were referenced from the library and website of the ASE and the HCMC market resource centre.

Prospectuses provide data for each of the issues regarding the offer price, total gross proceeds, age of companies, proportion of shares sold by owners, list of underwriters, and closing date of the offer. Other additional information about the companies comes from databases available at Compustat, Datastream and Thomson Financial Securities Data Corporation, at the public libraries of ASE and the HCMC, the library of the Bank of Greece and the database of the Greek Parliament. In a few cases, we approached companies directly.

Please Insert Table 1 About Here

Table 1 provides a categorisation of the IPOs, into the three market boards of Greece (Main, Parallel and New). The highest number of IPOs was launched in 2000 with 53 cases (18 in the Main market and 35 in the Parallel market), followed by 46 IPOs in 1994 (36 in the Main market and 10 in the Parallel market). The lowest number of IPOs was registered in 2008 and 2009 (1 IPO in the Main market in each year). No IPOs took place in the years of the Greek financial crisis 2010-2013.

4.3 Test Methodology

In periods when there are no price limits the raw measure of underpricing is the percent first day return over the offer price. However, in periods when price limits are in force, the first day return is a curtailed measure of actual underpricing, whenever the price limit is actually reached. We use a simple procedure to compute the short term unconstrained return: returns of the second day are estimated if first-day returns are bounded by the daily limit. If second day returns are also bounded, returns of the third day are estimated. The process goes on until the day when the price is formed without constraint. In summary, to compute the unconstrained return, we calculated – for each offering listed in the ASE during periods without price limits, the first day return; in the two sub-periods (July 1992-November 1996, and December 1996-November 1999) when price limits were in force, the return on the first day was recorded when it was unbounded. Finally, if price limits were effective, we computed the first unconstrained return, as described above. Calculations of raw and market adjusted underpricing returns are therefore as follows:

$$RAU_{i.t} = \frac{EP_{i,t} - OP_{i,0}}{OP_{i,0}} \quad (4) \qquad MAU_{i,t} = \frac{EP_{i,t} - OP_{i,0}}{OP_{i,0}} - \frac{MI_t - MI_0}{MI_0} \quad (5), \text{ where:}$$

t denotes the first day with unconstrained return, $OP_{i,0}$ is the IPO offer price as per prospectus of company 'i', $EP_{i,t}$ is the unconstrained price (closing price of IPO of company 'i' at the end of trading day t), MI_t is the price of the General Index in ASE in the end of the first day of unconstrained trading, and MI_0 is the price of the General Index in ASE on the offer price day. Using these calculations we produce the estimate of unconstrained return (MAU).

Furthermore, to test for returns free of other systematic influences (i.e. industry-specific shocks), we provide an alternative definition where the returns are further adjusted for industry specific disturbances:

$$MAUR_{(i,j,t)} = \frac{EP_{i,j,t} - OP_{i,j,0}}{OP_{i,j,0}} - \frac{MI_t - MI_0}{MI_0} - \frac{OII_{j,t} - OII_{j,0}}{OII_{j,0}} \quad (6) \quad \text{where:}$$

$OII_{j,t}$ is the index of industry group j, orthogonal to the market index[2], and i depicts the company, j depicts the industry and t depicts the time period.

4.4 Descriptive Statistics

Table 2 shows descriptive statistics of raw and market adjusted initial returns. It also shows statistics on the number of days required for prices to reach an unconstrained level during periods of active price limits.

Specifically, Panel A of Table 2 shows the mean (median) unadjusted and market adjusted returns for each of the regulatory sub-periods. The mean unadjusted return at the end of the first trading day, when no ceiling restriction was present, is 43.74 percent. The market adjusted return in the same period is 44.10 percent. During the period with the limit of ±8 percent, the unconstrained unadjusted return is 26.22 percent, whereas the corresponding market adjusted return has a mean of 29.62 percent.

Please Insert Table 2 About Here

During the period with a limit of ±99 percent, the mean unconstrained return is 112.88 percent and the market adjusted return is 105.66 percent. What is notable is that whereas average returns of the period with the ±8 percent limit are lower than those of the unconstrained period, the returns of the period with the ±99 percent limit are much higher than all others. This difference is attributable to the fact that the period with the ±99 percent limit includes a 'hot market' incident with the highest returns ever observed in the Greek market. This will of course be taken into account in the regression tests that follow.

During the sub-period where the price limit was at ±8 percent, 2.59 days were required on average to reach an unconstrained price (Panel C of Table 2). It is worth noting that of the 93 IPOs launched in this period 26 reached an unconstrained price on the first trading day, 14 on the

[2] OII is computed as the residual from the regression of each industry index on contemporaneous values of the market index.

second, 12 on the third and 20 on the fourth day. In other words, in about 80 percent of the cases the unconstrained price was reached within the first four days of trading. In the extreme cases, two IPOs recorded their unconstrained price after 10 and 11 trading days respectively.

In the period when the price limit was at ±99 percent, the mean number of days required to reach an unconstrained level was 0.67. In other words, on average, IPO returns reached their unconstrained level within the first trading day. Thus, 38 out of 67 IPOs reached an unconstrained price on the first trading day and 17 on the second day. Thus, 82 percent of IPOs reached an unconstrained price within two trading days. In extreme cases however, the shares in four IPOs rose by 99 percent for three consecutive days. Thus, even the wide constraint of ±99 percent proved to be binding in a significant number of cases and this was clearly related to the 'hot market' incident of 1999.

In Table 3 we show descriptive statistics for initial returns and for some of the main control variables broken down by period and by listing board classification.

Please Insert Table 3 About Here

The main observation in Table 3 is that underpricing is consistently higher in the parallel and new markets as compared to the main market. Prima facie this is an expected result as the quality of information is expected to be lower in companies entering the parallel and new markets, which are generally perceived as riskier placements.

Overall, average underpricing is registered at a quite high level: it is 52.63 percent for the entire sample, 37.04 percent for the main market and 71.21 percent for the parallel market.

4.5 Regulatory Variables

We define two binary dummy variables, one for each of the two periods with price limits on daily variation. Thus, CAP99 represents periods when a daily limit of ±99 percent that applied to the first three days of trading; CAP8 represents periods with the ±8 percent price limit.

The specification of the regulatory dummy variables implies of course that periods with no price limits are considered uniformly as 'unregulated' periods.

We also introduce a variable that takes the value of 1 if book-building has been used and 0 otherwise. As we mentioned above, book-building became mandatory for IPOs above a size of 25 billion drachmas on January 31 of 2000, and was finally imposed for all IPOs on July 8 of 2004.

4.6 Control Variables

We must consider market conditions, especially as our sample contains visible 'hot market' incidents. Loughran and Ritter [(2002), (2004)][3] report that underpricing increases substantially in a 'hot market' and then falls in the cold market. Lowry and Schwert (2002), Benveniste *et al.* (2003) and Derrien and Womack (2003) suggest after measuring the relationship of the initial return with market movements, that companies should choose the cold issue market to go public so that they can gain from higher prices of hot periods.

The selection of variables that discriminate 'hot periods' is an important issue, as it may be the case that different regulatory regimes coincide with different states of the market. Market conditions may be detected on the basis of a double criterion on a quarterly basis: on one hand, the number of IPOs performed during the quarter and on the other hand, ex-post market returns for the quarter. The use of these two variables is an extended version of the methodology used by Yung et al. (2008) and Boehme and Colak (2012). We use two continuous variables that capture respectively entrepreneur sentiment (on the supply side of IPOs) and investor sentiment (on the demand side of IPOs). The first is NUIPO which represents the ratio of the number of IPOs in each quarter to the quarterly average of IPOs in the entire sample period. The second is RET and represents the ratio of each quarter's market return to the overall average quarterly return over the entire sample period.

[3] Loughran and Ritter (2002, 2004) find that underwriters allocate hot IPOs to investors in return for commission business and they receive greater profits from commission business when there is greater underpricing.

Thus, compared to previously used methodology, this study utilizes two rather than one 'hot market' variables and they are continuous rather than dummy variables. In this manner the tests can capture more accurately market sentiment on both sides of the market. We hypothesize, in line with the extant literature, that underpricing is positively related to both NUIPO and RET.

Test methodology must control for many other factors in order to make effective comparisons between regulatory regimes in a cross-sectional model. We therefore apply a series of additional control variables, inspired from the literature. These control variables are: listing board classification (LBC), age of the firm at the date it goes public (AGE), privatization (PRIV) in the case of public sector companies, company size (SIZE), oversubscription (OVER), underwriters' reputation (UR), given ownership (GO) and industry type (IND). We also tested for variables of sectoral concentration of IPOs in specific periods.

Listing Board Classification: Secondary (parallel) markets provide younger and less well-established firms with the opportunity to raise funds at the IPO market and in follow-on offerings. Vismara et al (2012) find that the long-run performance of second-market IPOs in Europe is poor relative to that of main market IPOs: 3-year buy-and-hold abnormal returns of −19.0% for second-market IPOs vs +12.3% for main market IPOs. In this study, we distinguish firms listed in the *Main* board from those listed in the *Parallel* or *New* market. However, the *New* Markets' IPOs were restricted to a few novelty firms, as in most European Countries, [Bornardo et al. (2011)]. We therefore group them together with the *Parallel* market Vismara et. al (2012).

Age: Age represents the number of years of operating history of a firm prior to going public. Following Ritter (1984) we use this variable as a proxy for quality of information.

Privatization: Privatization is the transfer of ownership from state owned enterprises to private investors through IPOs. Following Perotti and Guney (1993) and Jones et. al (1999) we attach a value of 1 to IPOs of privatizing public sector firms.

SIZE: Zarowin (1990) documents that as smaller firms tend, on average, to be more risky, first day returns are expected to be bearish related to firm size.

Oversubscription: Oversubscription occurs when demand for shares exceeds the supply of shares offered for sale in a fixed price sale. As a result, the underwriters or investment bankers must allocate the shares among investors. Keloharju (1993) and Deloof et al. (2009) report that a higher oversubscription reflects the greater absorption capacity of the market.

Underwriter reputation: The lead underwriter plays an important role in pricing and distributing an IPO, certifying the quality of the issue by their past performance in IPO underwriting. In line with the underwriter certification hypothesis, issuers affiliated with more reputable underwriters are likely to exhibit lower underpricing. Beatty and Ritter (1986), Carter and Manaster (1990), Kim and Ritter (1999) and Ljungqvist and Wilhelm (2002), Migliorati and Vismara (2013) specify that prestigious underwriters are associated with lower risk offerings and lower initial returns expected from IPOs underwritten by reputable banks. Additionally much of the extant empirical literature find a negative relationship between underwriter reputation and level of fees [e.g. Kim, Palia and Saunders, (2010)]. However, there is also opposing evidence that suggests that underpricing may include a component of underwriter compensation, Hansen and Tarregrosa (1992). In the Greek data we use the dummy variable with value 1 for all IPOs underwritten by five 'major' underwriter banks, as opposed to other smaller banks and investment service firms.

Given Ownership: This is the percentage of ownership sold by pre-IPO shareholders. By selling a small percentage of their firm, original owners may signal firm quality (Habib and Ljungqvist (2001)).

Industry classification: IPOs are classified in groups based on their sector. Gajewski and Gresse (2006) use industry as a variable that affects average initial underpricing. Spiess and Pettway (1995) working on a sample of industrial firms find that initial underpricing is significantly

lower[4]. Our dummy variable takes the value 1 for manufacturing sectors and 0 for service industries.

Sectoral concentrations: During the period of study there were instances in which firms belonging to a single sector performed numerous IPOs within short periods. A large number (25) of construction companies were listed in the Athens Stock Exchange during 1993-1994 while many IT companies (17) were listed during the IT boom of 1999-2001. Further, many media and print companies (11) were listed during 1998-2000. These sectoral clusters of IPO supply could indicate a form of sectoral sentiment over and above other measures of supply competition. Thus, we tested three dummy variables (CONS), (IT) and (MED) which take a value of 1 for the corresponding IPOs. These variables were never significant so we skip them in the estimations and results which follow[5].

Appendix A summarizes the explanatory variables, briefly giving their definition and measurements. The main regression model is specified as follows:

$$\text{MAU or MAUR} = a_0 + \gamma_1 \text{LBC} + \gamma_2 \text{AGE} + \gamma_3 \text{PRIV} + \gamma_4 \text{SIZE} + \gamma_5 \text{OVER} + \gamma_6 \text{UR} + \gamma_7 \text{RET} + \gamma_8 \text{NUIPO} + \gamma_9 \text{GO} + \gamma_{10} \text{IND} + \gamma_{11} \text{PC8} + \gamma_{12} \text{PC99} + \gamma_{13} \text{BB} + \varepsilon_i \qquad (7)$$

If the regulatory price limits effectively lower underpricing, we expect to find that,

$$\gamma_{11} < \gamma_{12} < 0 \qquad (8$$

The effect of book-building on underpricing will be captured by γ_{13}.

[4] We defined as 'industrial' IPOs those firms which belong to Chemical, Manufacturing, Metals, Minerals & Shipyards sub-sectors and attached to them a value of one. Non-industrial categories are mainly Conglomerates, Real Estate/Property, Transportation, Tourism and Hotels etc. These take the value of zero.

[5] We also located a few firms whose IPO included overallotment options (green shoe). We tested a dummy variable for these cases but no significant results were found. We also collected data on institutional allocations (INAL) which were however available only after 1998. We use this variable only in the sample partition that includes the 'no limit' period. See below, section 5.3.

5. Empirical Results

5.1 Tests on the Entire Sample

The estimation of equation (8) is our basic test for the entire sample and is shown in Table 4. Four estimations are shown, including in turn the control variables and the regulatory variables (price limit dummies and book-building). The dependent variable is the market adjusted unconstrained return MAU[6].

Please Insert Table 4 About Here

Focusing first on the regulatory variables, which are the central issue in these tests, we see that only PC8 - the dummy representing periods with an 8 percent daily limit - obtains a significant negative coefficient. Other regulatory variables, PC99 (the 99 percent limit) and book-building do not obtain significant coefficients. The non-significance of PC99 implies that regulation of daily variation was indeed neutral towards underpricing during the period 1996-1999[7]. The non-significance of book-building, which as we said was mandated from 2001 onwards, is equally telling since it implies that at the level of the overall sample its imposition did not correct underpricing on average. (This conclusion is revisited below in 5.2. with sample partitions).

Among the control variables there are two which exert a consistent positive and significant effect on underpricing. These are over-subscription and the percent of given ownership. Size also appears as a significant negative influence on underpricing. All effects are in the expected direction and in line with international evidence. More specifically, whereas a positive effect of oversubscription reveals the amount of demand pressure at the time of placement, the effects of size and given ownership are proxies of the degree of asymmetry of

[6] In this and all subsequent estimations we have excluded one extreme outlier that occurred during the 'hot' 1999 period and offered an unconstrained return exceeding 700 percent.

[7] The variable PC99 was not significant in any of the remaining tests. Thus, it has been skipped in the Tables that follow.

information. We note here that all market segments are included in this first test, whereas more specific tests by market venue follow next.

5.2 Sample Partition by Market Venue

Vismara et al. (2012) indicate that European stock exchanges have repeatedly opened second markets to list small companies. Greece's stock exchange followed this rule and established the secondary market in 1989. We take advantage of this regulatory initiative and in Table 5, we test the model of underpricing on subsamples defined by the different segments of the market. The partition of the sample isolates the main market on one hand and the parallel and new markets on the other. As we have already seen in descriptive statistics (Table 2) the two segments differ in the average size of offering and in the average degree of underpricing. Furthermore, the less severe listing requirements that hold for the parallel and new markets imply that IPOs in that segment probably belong to higher risk classes and involve higher information asymmetries. In Table 5 we perform estimations of equation (8) separately for the two market segments.

Please Insert Table 5 About Here

Looking first at the estimations for the main market – a sample of 183 IPOs – we note several important findings. Regulatory variables are again significant and wield considerable explanatory power. In the first place, the variable associated with the strict variation limit PC8 appears again to exercise a significant and negative influence on average underpricing, as was found in the overall sample. However, in contrast to the overall sample, the introduction of book-building is now shown to also exert a significant negative influence. Thus, it appears that the succession of regulatory devices - a price limit in the early period and mandatory book-building in the later period – were both effective in reducing average underpricing in the Greek IPO

market. The difference between these two devices is, according to our interpretation, illuminating. Price limits have acted indirectly by reducing incentives to under-price. Book-building has operated directly on the process of determination of offer prices and has allowed underwriters to gauge more effectively the limits of demand for new issues. Focusing at the results for non-regulatory variables we further note that oversubscription, as in the case of the entire sample, exerts strong positive influence on underpricing.

Turning now to the parallel market, we note strong similarities but also differences. On the regulatory front, the role of PC8 is the same as in the main market, indicating that strict variation limits have reduced average underpricing; on the other hand, book-building is not significant. Over-subscription is uniformly significant everywhere. Furthermore, size also exhibits a negative effect here, as in the overall sample. The one variable that emerges as significant in the case of the parallel market is the one describing 'underwriters reputation' (UR). This variable obtains a significant negative coefficient. This strong result verifies that in the case of the risky and less known firms placing IPOs in the parallel (or new) market, the certification value of a reputable underwriter encourages considerable reduction in underpricing.

5.3 Sample Partition by Regulatory Regime

We have chosen a second type of partition of the sample, in order to offer a more direct comparison between two regimes, one with strict limits and the other without any limits. Estimations for these two basic regimes are shown below as columns 1 and 2 of Table 6. The no-limit period itself is subdivided further into two sub-periods: the period prior to June 1992 and the period after December 1999, shown here (column 1). We have excluded the period of the 99 percent limit in this examination, as we want to establish a comparison between two 'clean' regimes, one with strict limits and one without limits at all. In the last sub-period, post December 1999, we have also included book-building (BB) and the variable institutional allocation (INAL)

which measures institutional allocation for each IPO. This variable is not uniformly available in earlier periods.

Lastly, we have also separated out the cases in which book-building was used as a distinct regime within the more general no-limit category. In estimating the equation for underpricing we have added the variable price revision (PREV) which measures the difference between the offer price and the mid-point of the book-building price range. This variable has been used in empirical studies of book-building [Hanley (1993), Sherman (2000), Cornelli and Goldreich (2001), Jenkinson and Jones (2004)] and there is some theoretical work on its significance in the European context [Jenkinson et. al. (2006)].

Please Insert Table 6 About Here

In the period with strict variation limits (column 2) we note, once again, that over-subscription is a strong positive determinant of underpricing. In addition, the variable measuring frequency of IPOs in any given quarter obtains a strong positive coefficient. This implies that pressure of competitive offerings increased underpricing.

Turning to the no-limit regime (column 3), we note that over-subscription and the frequency of IPOs are consistently positive contributors to underpricing but that several important differences also arise. The size variable acquires a negative significant coefficient much in line with international evidence. The variable measuring the percent of ownership ceded in the IPO (GO) is also positive and significant in this regime. This is again in line with international evidence and indicates that as the share of ownership retained by original owners shrinks, the enticement of new investors requires higher price discounts.

Neither book-building nor institutional allocations present any significant influence on underpricing in this sample segment. On the other hand, in the sample which includes book-

building cases exclusively (column 4), the variable 'PREV' obtains a positive coefficient, implying that positive price revisions are correlated with higher ex-post initial returns.

6. Robustness Checks

6.1 The 'Hot' Period and Regulatory States

Our empirical tests cover a long period in which different market phases are distinct. The period during which price limits were phased out includes a 'hot market' phase during which, as we showed, returns in the Greek market reached unprecedented high levels and this included first day returns of IPOs. Despite the use of control variables for the 'hot market' incident of 1999, there is still concern that the findings of lower returns in the regulated period is driven by uncharacteristically high returns in a portion of the unregulated period. We address this concern by conducting alternative checks of the robustness of our results by a series of exclusions of observations associated with the 'hot market' incident.

Besides the 'hot market', one feature of the change in the regulatory environment may also be the source of possible distortion: until mid 1992, there were no price limits at all whereas after that time price limits were imposed on the market as a whole, to be gradually relaxed after 1999. One could argue that in the early (pre-1992) period the behavior of the market index, which we use for the adjustment of raw returns, was unconstrained and hence different from that of the ensuing period. Considering the whole population of listed companies however, casual observation suggests that only a few of their prices were hitting the price limit on any one day, so that their impact on the general market index was minimal. Nevertheless, and since this is an empirical issue, we re-estimate our basic regression excluding IPOs conducted from 1990 to mid 1992, when there were no limits at all.

Three different exclusions are tested for robustness with respect to the 'hot market' of 1999. In the first, we exclude seven outliers in which first day returns exceeded 300 percent and all of which occurred in the 'hot market' period. In the second, we exclude all observations from

the very hot third and fourth quarters of 1999. In the third test, we run our basic regression only for the period 1990-1998, excluding observations both from the very hot market period of 1999 and its aftermath.

We also conduct two re-estimations excluding observations from 1990 to mid-1992, the period of no general price limits. In the fourth column we re-estimate the basic regression also excluding the seven outliers of 1999; in the fifth column we present results after exclusion, besides pre-1992 IPOs, of the third and fourth quarters of 1999. In Table 7 we show the results of these regressions.

Please Insert Table 7 About Here

The immediate observation from the estimations in Table 7 is that our main findings persist with the same directions of signs and similar levels of significance as in the main tests. More specifically the main regulatory variable PC8 remains consistently negative and significant in all tests.

It can therefore be safely concluded that the main findings are not driven by market condition and are robust.

6.2 Industry Effects

The adjustment of raw IPO returns by simultaneous market returns may leave out other systematic shocks such as industry effects. We have therefore formed an additional estimate of the dependent variable – MAUR – which embodies industry adjustments. This has been possible for only a portion of our sample however. Indices of industry groupings are estimated and published by the Athens Stock Exchange, but during most of our sample period their coverage of listed companies did not extend to the whole population. We have utilized five published indices: manufacturing, holding companies, investments, construction and wholesale trade. Using available time-series of these indices we have first extracted their orthogonal component to the

market index. We then matched IPOs to the sectors covered by these indices and adjusted raw returns using both market and industry returns. This resulted in a sample of 102 IPOs. Estimations of the basic regressions with the new variable MAUR are shown in Table 8. In the first three columns we re-estimate the main model. Columns 4 and 5 include estimations by partitioning into the main and the parallel markets.

Please Insert Table 8 About Here

The results of the estimation of the main model using the market- and industry-adjusted MAUR are very similar to those found earlier, with strong and negative significant coefficients attaching both to price limit variable PC8 and the book-building variable BB. The strength of the results is underlined by the fact that use of the industry indices has reduced the sample to less than half its original size, but nevertheless the regulatory variables remain strongly significant. When we proceed to the partition into main and parallel markets however, samples are quite small and only PC8 retains its significance in the main market stratum. We conclude again that our overall results are robust.

7. Discussion of Results

All our evidence shows that while strict price limits were in force, IPO underpricing was much less severe in the Athens Stock Exchange. There is considerable detail that arises from our empirical work that must be added to this broad conclusion.

First, we must consider the broader context of the tests. The Athens Stock Exchange experienced high underpricing, which averaged 52.63 percent for the entire sample period considered. Price limits did not eliminate underpricing but associated with a visible reduction. Secondly, the Greek market underwent considerable expansion during the sample period, with a distinct growth in volume and prices in 1999. This ‘boom’ period coincided with record

underpricing and took place after strict price limits had been phased out. In order to ensure that this 'boom' period does not distort our results, we have used control variables that capture market conditions (RET and NUIPO) and which appear significant in a number of our tests. We have also conducted extensive tests of robustness. We are confident that the estimated effect of price limits does not simply arise from differences in market conditions.

The more severe underpricing that is found in the parallel and new markets as compared to the main market is observable both in periods with and without price limits. This is a clear indication that information asymmetries lie at the root of the underpricing phenomenon, since there is a 'class distinction' between firms entering the main market and those entering the parallel and new markets by virtue of different listing requirements.

Finally, findings indicate that when the sample is partitioned by regulatory regime, we can conclude that under different regulatory regimes, different variables become relevant. Further research on samples limited within one or the other period may lead to different but valid conclusions. Hence, institutional detail matters very much and regulatory changes should be carefully accounted for in tests of this type.

8. Summary and Conclusions

We conducted a direct test of the impact of price limits on IPO underpricing. There has been no other such direct test to our knowledge. The Greek market has offered this unique opportunity for testing, as daily variation limits for newly listed shares changed three times in a process of liberalization over seven years.

Our basic finding supports the hypothesis that price limits actually reduce underpricing. This contradicts general statements that regulatory intervention increases underpricing. In part, the contradiction is due to the fact that direct intervention with price limits, or successive limit relaxations within a few years in the same Exchange have not been tested before. Our evidence is clear since

this effect appears strong not only when we compare a period with narrow limits with a period with no limits, but also when we compare periods with limits of different range.

Routine regulatory explanations of price limits focus on the reduction of speculation and the moderation of market volatility. The results we obtained show an unexpected gain in efficiency in the pricing of newly listed stocks which has not been previously recognized by researchers, nor has been explicitly embedded in regulatory arguments. Nevertheless, as the recent example of Indian regulation shows, price limits on early trading of IPO shares is used in an anti-manipulation context.

Our findings are robust, as we have tested for the possible interference of 'hot market' and other conditions, the possible effect of industry factors and a number of control variables. An important finding is that in regulated and unregulated periods the role of control variables changes. This suggests that empirical tests are sensitive to institutional arrangements and that different regulatory restrictions may lead to validation of different models. This finding has direct implications for research design.

An underlying implication of our findings is that market participants (issuers, underwriters, investors) adjust their behavior to the regulatory environment, as this may change incentives for underpricing. A variant of this implication, in the spirit of Boehme and Colak (2012), is that the population of participating investors is itself changing not only during hot IPO markets but also during periods when price limits are imposed. Clearly this is a matter that merits further research.

Appendix A. Variables Definitions

Variable Name in Abbreviation	Variable Definition	Type of Measure	Expected Sign
	Panel A: Measures of Abnormal Returns		
RAU	Level of underpricing (unconstrained or fair market price) which considers 2nd, 3rd etc days of trading until the price will reach its unconstrained level.	Continuous	
MAU	Calculates the level of underpricing by the time the unconstrained price will occur. Returns are adjusted for the market effect.	Continuous	
MAUR	Calculates the level of underpricing adjusted for industry specific shocks.	Continuous	
	Panel B: IPOs Characteristics		
LBC	Dummy variable: 1 if an IPO is listed in Main Market and '0' if listed in Parallel or New Market.	Discrete	+
AGE	Age of the firm starting from the year of its establishment until the year it goes public.	Continuous	-
PRIV	Companies owed by the State before going public. State sells part of its holdings on those companies in the market.	Discrete	+
SIZE	Market capitalization measured by the log of the total number of outstanding shares after the IPO multiplied by price per share.	Continuous	-
OVER	Oversubscription on the number of shares issued.	Continuous	+
UR	Dummy variable: 1 for reputable underwriters (major banks), 0 otherwise.	Discrete	-
GO	Proportion of given ownership during the going public process.	Continuous	+
IND	Dummy variable: 1 for industrial companies, 0 otherwise.	Discrete	-
	Panel C: Market Characteristics		
RET	Quarterly market rate of return divided by overall quarterly average.	Continuous	-
NUIPO	Quarterly number of IPOs divided by the average number of IPOs in all quarters.	Continuous	+
INAL	The percentage of shares allocated to institutional investors during the public offering process.	Continuous	-
PREV	Price Revision is the difference between the IPO offer price and the centre of the price range in the case of offers with book-building.	Continuous	+
GS	Green Shoe or overallotment allows underwriters to sell additional shares at the offering price; dummy variable takes value of 1 if Green shoe is present.	Discrete	+
BB	Book-building is the process of recording investor demand for shares during an IPO in order to support efficient price discovery. Dummy variable with value 1.	Discrete	-
	Panel D: Price Limit Characteristics		
Cap ±8%	Dummy variable: 1 IPOs listed with a price cap limitation of ±8%, otherwise 0 Cap ±8%: IPOs listed in ASE with a price cap limitation of ±8% during Nov. 1993 – Nov. 1996 period.	Discrete	-
Cap ±99%	Dummy variable: 1 IPOs listed with a price cap limitation of ±99%, otherwise 0 Cap ±99%: IPOs listed in ASE during Dec. 1996 - Dec. 1999 period.	Discrete	-

Appendix B. Underpricing of Greek IPOs (Quarterly Returns)

The appendix classifies the four regulatory periods by quarter. Those are from January 1, 1990 to June 30, 1992 (trading without limits), July 1, 1992 to November 30, 1996 (limit of ±8%), December 1, 1996 to November 30, 1999 (limit of ±99%) and finally from December 1, 1999 to December 31, 2013 (trading without limits). From last quarter of 2009 till last quarter of 2013 no IPO was listed in the Athens Stock Exchange.

	Quarter	No of IPOs	Mean of RAU (%)	Mean of MAU (%)
	Jan 1990 – Mar 1990	4	129.26	114.34
	Apr 1990 – June 1990	5	147.65	116.14
	July 1990 – Sep 1990	9	94.12	96.89
	Oct 1990 – Dec 1990	10	27.52	30.48
	Jan 1991 – Mar 1991	2	30.44	10.77
	Apr 1991 – June 1991	5	47.18	51.90
	July 1991 – Sep 1991	6	34.35	37.00
No ceiling	Oct 1991 – Dec 1991	1	-12.39	-14.98
	Jan 1992 – Mar 1992	3	-15.66	-14.29
	Apr 1992 – June 1992	1	9.72	7.39
	July 1992 – Sep 1992	1	-18.86	-31.67
	Oct 1992 – Dec 1992	0	-	-
	Jan 1993 – Mar 1993	0	-	-
	Apr 1993 – June 1993	0	-	-
	July 1993 – Sep 1993	5	17.33	5.94
	Oct 1993 – Dec 1993	5	31.07	17.43
	Jan 1994 – Mar 1994	3	94.39	94.16
	Apr 1994 – June 1994	14	19.94	41.01
	July 1994 – Sep 1994	12	26.00	34.63
	Oct 1994 – Dec 1994	17	22.06	25.29
	Jan 1995 – Mar 1995	3	22.45	24.52
	Apr 1995 – June 1995	5	-2.55	-4.99
±8% Cap	July 1995 – Sep 1995	6	40.65	37.79
	Oct 1995 – Dec 1995	6	36.83	39.71
	Jan 1996 – Mar 1996	7	29.86	28.06
	Apr 1996 – June 1996	4	18.96	22.02
	July 1996 – Sep 1996	5	16.76	15.67
	Oct 1996 – Nov 1996	1	34.16	34.59
	Dec 1996 - Mar 1997	5	5.79	1.70
	Apr 1997 – June 1997	4	17.84	10.83
	July 1997 – Sep 1997	4	51.79	51.83
	Oct 1997 – Dec 1997	2	100.76	108.79
	Jan 1998 – Mar 1998	5	74.68	64.06
	Apr 1998 – June 1998	3	93.21	70.78
	July 1998 – Sep 1998	7	91.56	91.45
	Oct 1998 – Dec 1998	8	51.54	44.06
±99% Cap	Jan 1999 – Mar 1999	7	98.47	85.75
	Apr 1999 – June 1999	9	92.07	89.17
	July 1999 – Sep 1999	8	222.90	202.00
	Oct 1999 – Dec 1999	14	243.50	249.02
	Jan 2000 – Mar 2000	18	136.75	136.98
	Apr 2000 – June 2000	14	27.75	31.07
	July 2000 – Sep 2000	13	8.63	9.06
	Oct 2000 – Dec 2000	8	-2.99	-3.45
	Jan 2001 – Mar 2001	3	-0.67	4.58
	Apr 2001 – June 2001	7	69.87	68.26
	July 2001 – Sep 2001	5	-3.11	4.02
No ceiling	Oct 2001 – Dec 2001	6	42.54	47.21

Jan 2002 – Mar 2002	8	70.86	72.01
Apr 2002 – June 2002	4	-2.34	0.59
July 2002 – Sep 2002	7	13.57	17.56
Oct 2002 – Dec 2002	3	-11.16	-5.20
Jan 2003 – Mar 2003	5	-14.59	-15.17
Apr 2003 – June 2003	2	6.44	5.03
July 2003 – Sep 2003	6	19.83	7.77
Oct 2003 – Dec 2003	2	16.26	25.97
Jan 2004 – Mar 2004	6	-8.19	-3.82
Apr 2004 – June 2004	4	-2.67	1.45
July 2004 – Sep 2004	0	-	-
Oct 2004– Dec 2004	1	-3.72	-7.03
Jan 2005 – Mar 2005	0	-	-
Apr 2005 – June 2005	5	1.54	2.34
July 2005 – Sep 2005	1	-3.24	1.25
Oct 2005– Dec 2005	1	31.62	27.28
Jan 2006 – Mar 2006	0	-	-
Apr 2006– June 2006	2	10.40	10.83
July 2006 – Sep 2006	0	-	-
Oct 2006– Dec 2006	0	-	-
Jan 2007 – Mar 2007	0	-	-
Apr 2007– June 2007	1	94.72	92.69
July 2007 – Sep 2007	1	22.36	19.88
Oct 2007– Dec 2007	1	-4.90	-2.88
July 2008 – Sep 2008	1	-2.66	-2.95
July 2009 – Sep 2009*	1	4.0	2.5

* From the last quarter of 2009 till the last quarter of 2013 no IPO was listed in the Athens Stock Exchange.

Appendix C. List of Underwriters, 1990-2013

The largest banks (Reputable Underwriters) in Greece over the covered period are Alpha Bank, Commercial Bank, EFG Eurobank Ergasias, National Bank of Greece and Piraeus Bank.

Underwriters (Reputable)	**No of IPOs**	**Underwriters (Inexperienced)**	**No of IPOs**
EFG Eurobank - Ergasias	42	Agricultural Bank of Greece	12
Commercial Bank	49	ETEBA	18
National Bank of Greece	52	Bank of Chios	3
Piraeus Bank	39	Other Greek Banks	15
Alpha Bank	36	Foreign Banks	25
		Alpha Finance	18
		Other Financial Institutions	42
Total	218	Total	133
All Listed IPOs	351		

References

Baker, M. and Wurgler, J., 'Investor sentiment and the cross-section of stock returns', *Journal of Finance*, Vol 61, 2006, pp. 1645-1680.

Baker, M. and Wurgler, J. 'Investor sentiment in the stock market', *Journal of Economic Perspectives*, Vol 21, 2007 pp. 129-152.

Beatty, R. and Ritter, J., 'Investment banking, reputation, and the underpricing of initial public offerings', *Journal of Financial Economics, Vol* 15, 1986, pp. 213-232.

Benveniste, L., Ljungqvist, A., Wilhelm Jr., and Yu, X., 'Evidence of information spillovers in the production of investment banking services', *Journal of Finance, Vol* 58, 2003, pp. 577-608.

Boehme, R. and Colak, G., 'Idiosyncratic risk, short-sale constraints, and other market frictions in IPO stocks', *Journal of Financial Market, Vol 15*, 2012, pp. 286-327.

Bonardo, D., Paleari, S. and Vismara, S., 'Valuing university-based firms: The effects of academic affiliation on IPO performance', *Entrepreneurship Theory and Practice, Vol* 35, 2011, pp. 755-776.

Burhop, C., Chambers, D. and Cheffins, B., 'Regulating IPOs: Evidence from going public in London, 1900–1913', *Explorations in Economic History, Vol* 51, 2014, pp. 60-76.

Campbell, C., Du, Y., Rhee, G. and Tang, N., 'Market sentiment, IPO underpricing and valuation', 2009, *Working paper*, Iowa State University.

Carpentier, C., Cumming, D. and Suret, J.-M., 'The value of capital market regulation: IPOs versus reverse mergers', *Journal of Empirical Legal Studies* Vol 9, 2012, pp. 56-91.

Carter, B. and Manaster, S. 'Initial public offerings and the underwriter reputation', *Journal of Finance, Vol* 45, 1990, pp. 1045-1067.

Cestau, D., Green, R. and Schurhoff, N., 'Tax-subsidized underpricing: Issuers and underwriters in the market for build america bonds', 2012, *Working Paper, Carnegie Mellon University*.

Chambers, D. and Dimson, E., 'IPO underpricing over the very long run', *Journal of Finance, Vol* 64, 2009, 1407-1443.

Chan, K., Wang, J. and Wei, K.C.J., 'Underpricing and long-term performance of IPOs in China', *Journal of Corporate Finance* 10, 2004, pp. 409-430.

Chang, K., Kim, Y.C., Kim Y.S. and Thorton, J.H., 'Unintended regulatory consequenses:Evidence from korean IPOs', *Journal of Pacific Basin Journal* 20, 2012, 292-309.

Cheung, Y.L., Jing, L.H., Lu, T. and Rau, P.R., 'Tunneling and propping up: An analysis of related party transactions by chinese listed companies', *Pacific-Basin Finance Journal*, Vol 17, 2009, pp. 372-393.

Chowdhry, B. and Nanda, V., 'Leverage and market stability: The role of margin rules and price limits', *Journal of Business* Vol 71, 1998, pp. 179-210.

Cornelli, F., Goldreich D. and Ljungqvist, A., 'Investor sentiment and pre-IPO markets', *Journal of Finance*, Vol 66, 2006, pp. 1187-1216.

Cornelli, F. and Goldreich, D., 'Bookbuilding and strategic allocation', *Journal of Finance* Vol 56, 2001, pp. 2337-2369.

Deloof, M., DeMaeseneire W. and Inghelbrecht, K., 'How do investment banks value initial public offerings (IPOs)?', *Journal of Business Finance & Accounting Vol* 36, 2009, pp. 130-160.

Derrien, F. and Womack, K., 'Auction vs book-building and the control of underpricing in hot IPO markets', *Review of Financial Studies,Vol.* 16, 2003, pp. 31-61.

Diacogiannis, G.P., Patsalis, N., Tsangarakis, N.V. and Tsiritakis, E.D., 'Price limits and overreaction in the Athens Stock Exchange', *Applied Financial Economics*, 2005, Vol.15, pp. 53-61.

Dorsman, A. and Gounopoulos, D., 'European sovereign debt crisis and the performance of Dutch IPOs', *International Review of Financial Analysis*, Vol 30, 2013, pp. 308-319.

Ekkayokkaya, M. and Pengniti, T., 'Governance reform and IPO underpricing', *Journal of Corporate Finance*, Vol 18, 2012, pp. 238-253.

Fama, E. and French, K., 'Business conditions and expected on stocks and bonds', *Journal of Financial Economics* 25, 1989, pp. 23-49.

Fama, E. and French, K., 'Multifactor explanations of asset pricing anomalies', *Journal of Finance* 51, 1996, 55-84.

Gajewski, J.F. and Gresse, C., 'A survey of the European IPO market', 2006, *ECMI Paper*.

Gao, X., Ritter, J.R., and Zhu, Z., 'Where have all the IPOs gone?', *Journal of Financial and Quantitative Analysis, Vol 48, 2013*, 1663-1692

Habib, M. and Ljungqvist, A., 'Underpricing and entrepreneurial wealth losses in IPOs: theory and evidence', *Review of Financial Studies, Vol* 14, 2001, pp. 433-458.

Hanley, K., 'The underpricing of initial public offerings and the partial adjustment phenomenon', *Journal of Financial Economics, Vol* 34, 1993, pp. 231-250.

Hansen, R., and Torregrosa, P., 'Underwriter compensation and corporate monitoring', *Journal of Finance* Vol. 47, 1992, pp. 1537-1555.

Healy, P. and Palepu, K., 'Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature', *Journal of Accounting and Economics, Vol* 31, 2001, pp. 405-440

Jenkinson, T. and Jones, H., 'Bids and allocations in european IPO bookbuilding', *Journal of Finance, Vol* 59, 2004, pp. 2281-2308.

Jenkinson, T., Morrison, A. and Wilhelm J., 'Why are european IPO's so rarely priced outside the indicative price range?', *Journal of Financial Economics* Vol., 80, 2006, pp. 185-209.

Johnston, J. and Madura, J., 'The pricing of initial public offerings since the Sarbanes-Oxley Act', *Financial Review, Vol* 44, 2009, pp. 291-310.

Jones, S., Megginson, W., Nash, R. and Netter, J., 'Share issue privatizations as financial means to political and economic ends', *Journal of Financial Economics* Vol 53, 1999, pp. 217-253.

Kao, J., Wu, D. and Yang, Z., 'Regulations earnings management, and post-IPO performance: The chinese evidence', *Journal of Banking and Finance, Vol* 33, 2009, pp. 63-76.

Kazantzis, C. and Levis, M., 'Price support and initial public offerings: Evidence from Athens Stock Exchange', *Journal in International Business and Finance, Vol* 12, 1995, pp. 185-200.

Keloharju, M., 'The winner's curse, legal liability, and the long-run price performance of initial public offerings in Finland', *Journal of Financial Economics, Vol.* 34, 1993, pp. 251-277.

Kim, D., Palia, D. and Saunders, A., 'Are initial returns and underwriting spreads in equity issues complements or substitutes?', *Financial Management Vol* 39, 2010, pp. 1403-1423.

Kim, K. and Park, J., 'Why do price limits exist in stock markets? A manipulation-based explanation', *European Financial Management* Vol., 16, 2010, pp. 296-318.

Kim, M. and Ritter, J., 'Valuing IPOs', *Journal of Financial Economics* 53, 1999, pp. 409-437.

Kim, Y.H. and Yang, J.J., 'What makes circuit breakers attractive to financial markets? A survey', *Journal of Financial Markets, Institutions & Instruments* 13, 2004, pp. 107-146.

Laporta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R., 'Law and finance', *Journal of Political Economy,* Vol 106, 1998, pp. 1113-1155.

Leuz, C., and P.D. Wysocki, 'Economic consequences of financial reporting and disclosure regulation: A review and suggestions for future research', 2008, *Working paper, National Bureau of Economic Research (NBER).*

Ljungqvist, A. and Jr. Wilhelm, W., 'IPO allocations: Discriminatory or discretionary?', *Journal of Financial Economics, Vol* 65, 2002, pp. 167-201.

Loughran, T. and Ritter, J., 'Why don't issuers get upset about leaving money on the table of IPOs?', *Review of Financial Studies,Vol* 15, 2002, pp. 413-443.

Loughran, T. and Ritter, J., 'Why has IPO underpricing changed over time?', *Financial Management, Vol* 33, 2004, pp. 5-37.

Loughran, T., Ritter, J. and Rydqvist, K., 'Initial public offerings: 'International insights', *Pacific-Basin Finance Journal (An update is available on Jay Ritter's web site)* 2, 1994, pp. 165-199.

Lowry, M. and Schwert, W., 'IPO market cycles: Bubbles or sequential learning', *Journal of Finance, Vol* 57, 2002, pp. 1171-1200.

Migliorati, K. and Vismara, S., 'Ranking underwriters of European IPOs', *European Financial Management,2014, forthcoming.*

Mulherin, J.H., 'Measuring the costs and benefits of regulation: Conceptual issues in securities markets', *Journal of Corporate Finance, Vol* 13, 2007, pp. 421-437.

Perotti, E. and Guney, S., 'Successful privatization plans: Enhanced credibility through timing and pricing of sales', *Financial Management,Vol* 22, 1993, pp. 84–98.

Pettway, R. and Kaneko, T., 'The effects of removing price limits and introducing auctions upon short-term IPO returns: The case of Japanese IPOs', *Pacific-Basin Finance Journal* 4, 1996, pp. 241-258.

Phylaktis, K., Kavussanos, M. and Manalis, G., 'Price limits and stock market volatility in the athens stock exchange', *European Financial Management, Vol* 5, 1999, pp. 69–84.

Ritter, J., 'The hot issue market of 1980', *Journal of Business, Vol* 57, 1984, pp. 215-240.

Rock, K., 'Why new issues are underpriced', *Journal of Financial Economics, Vol* 15, 1986, pp. 187-212.

Ruud, J., 'Underwriter price support and the IPO underpricing puzzle', *Journal of Financial Economics, Vol* 34, 1993, pp. 135-151.

Sherman, A., 'IPO and long-term relationships: An advantage of bookbuilding', *The Review of Financial Studies, Vol* 13, 2000, pp. 697-714.

Sherman, A. and Titman, S. 'Building the IPO order book: Underpricing and participation limits with costly information', *Journal of Financial Economics, Vol* 65, 2002, pp. 3-29.

Shleifer, A., 'Understanding regulation', *European Financial Management* 11, 2005, pp. 439–451.

Spiess, D. and Affleck-Graves, J. 'Underperformance in long-run stock returns following seasoned equity offerings', *Journal of Financial Economics* 38, 1995, pp. 243-268.

Thomadakis, S., Gounopoulos, D. and Nounis, C., 'The long term performance of initial public offerings in the Athens Stock Exchange', *European Financial Management* 17, 2012, pp. 117-141.

Thomadakis, S., Gounopoulos, D., Nounis, C. and Riginos, M., 'Financial innovation and growth: Listing and IPOs from 1880 to World War II', 2014, *Working Paper*, London School of Economics.

Tian, L., 2011, 'Regulatory underpricing: Determinants of chinese extreme IPO returns, *Journal of Empirical Finance*' 18, 2011, pp. 78-90.
Vismara, S., Paleari, S. and Ritter, J., 'Europe's second markets for small companies', *European Financial Management* 18, 2012, pp. 352-388.
Yung, C., Colak, G. and Wang, W., 'Cycles in the IPO market', *Journal of Financial Economics* 89, 2008, pp. 192-208.
Zarowin, P., 'Size, seasonality and stock market overreaction', *Journal of Financial and Quantitative Analysis* 25, 1990, pp. 113-125.
Zingales, L., 'The future of securities regulation', *Journal of Accounting Research* 47, 2009, pp. 391-425.

Table 1
Greek IPO Sample Description

The table presents details of the Greek IPOs by market of listing (main, parallel, new) in every calendar year and total annual capital raised by IPOs.

Event Year	IPO firms full sample	Main Market	Parallel Market	New Market	Total Capital Raised '000 Euros
1990	28	23	5	-	108,418
1991	14	11	3	-	124,191
1992	5	5	-	-	26.560
1993	10	10	-	-	60,983
1994	46	36	10	-	263,360
1995	20	10	10	-	70,003
1996	20	7	13	-	336,562
1997	12	3	9	-	50,743
1998	23	10	13	-	924,061
1999	38	15	23	-	1,182,523
2000	53	18	35	-	2,842,882
2001	21	13	6	2	1,497,054
2002	21	8	9	4	99,712
2003	15	1	12	2	121,332
2004	11	4	4	3	87,126
2005	7	3	3	1	81,860
2006	2	2	-	-	725,248
2007	3	3	-	-	500,733
2008	1	1	-	-	23,337
2009	1	1	-	-	10,000
2010	0	-	-	-	-
2011	0	-	-	-	-
2012	0	-	-	-	-
2013	0	-	-	-	-
Total	**351**	**184**	**155**	**12**	**8,791,468**

Table 2
Distribution of Raw and Market Adjusted Initial Returns

This table presents in panel A shows the initial returns at the end of the first day of unconstrained trading. Panel B shows maximum and minimum underpricing (equilibrium or fair market price) which considers 2nd, 3rd etc. days of trading until the IPO will reach its equilibrium. Panel C indicates the number of days in which prices of IPOs reached the upper price limit during early trading in ASE. Panel D highlights the number of cases clearing on the first, second and later trading days (Price limit ±8%). Panel E highlights the number of cases clearing on the first, second, and later trading days (Price limit ±99%) The raw underpricing (returns reach their equilibrium price in more than one day of trading in the cases of price cap) is measured as $RAUi,t=(EP_{i,t}-OP_{i,0})/OP_{i,0}$. The Market Adjusted Underpricing (MAU) is calculated as $MAU=[(EP_{i,t}-OP_{i,0})/OP_{i,0}-(MI_{i,t}-MI_{i,0}/M_{i,0})]$. Overall the sample as appears in Figure 1 is divided into four periods. These periods are from January 1, 1990 to June 30, 1992 (trading without limits), July 1, 1992 to November 30, 1996 (limit of ±8%), December 1, 1996 to November 30, 1999 (limit of ±99%) and finally from December 1, 1999 to December 31, 2013 (trading without limits).

Panel A: Division of the sample into four periods based on regulation of daily variation

	Period	No of IPOs	Mean (median) of RAU (%)	Mean (median) of MAU (%)
No ceiling	Jan 1990 – Dec 2013	191	43.74 (12.47)	44.10 (16.23)
	Jan 1990 – Jun 1992	47	56.00 (33.39)	52.15 (36.49)
	Dec 1999 - Dec 2013	144	40.55 (10.32)	41.86 (12.64)
±8% limit	Jul 1992 - Nov 1996	93	26.22 (16.84)	29.62 (23.48)
±99% limit	Dec 1996 - Nov 1999	67	112.88 (84.57)	105.66 (70.80)
Overall	Jan 1990 – Dec 2013	351	52.48 (22.51)	52.15 (24.27)

Panel B: Maximum and Minimum value of IPO initial performance and Underpricing

	No of IPOs	Max (min) of RAU (%)	Max (min) of MAU
No ceiling	191	472.24 (-76.67)	472.34 (-67.35)
±8% limit	93	133.17 (-8.00)	120.82 (-17.30)
±99% limit	67	751.07 (-4.54)	748.00 (-41.84)
Overall	351	751.07 (-76.67)	748.00 (-41.84)

Panel C: Number of days in which prices of IPOs hit their price limit during early trading in ASE

	Period with price limit: ±8%	Period with price lim it: ±99%
Mean	2.59	0.67
Median	2.00	0.00
Standard Deviation	2.80	0.88
Minimum no of limit hits (ups or downs)	0.00	0.00
Maximum no of consecutive 'limit ups'	11	3
Maximum no of consecutive 'limit downs'	1	0

Panel D: No of cases clearing on the first, second, and later trading days (Price limit ±8%)

Continuous Limit Ups	Obs.	MAU	Size (m €)	Age	Given Own.
0	26	0.567	5,889	15.11	23.37
1	14	19.01	19,883	18.42	21.74
2	12	25.15	4,550	14.91	21.35
3	20	27.44	4,964	19.1	21.92
4	4	60.20	6,621	17.75	23.13
5	3	55.23	2,329	30.3	19.67
6	3	56.72	2,009	13.33	35.83
7	4	89.39	2,645	28.25	19.34
8	3	78.48	1,342	12.33	16.02
9-11	4	113.53	2,150	19.5	19.55

Panel E: No of cases clearing on the first, second, and later trading days (Price limit ±99%)

Continuous Limit Ups	Obs.	MAU	Size (m €)	Age	Given Own.
0	38	31.71	28,849	19.5	18.71
1	17	151.8	16,364	19.8	19.52
2	8	90.59	17,229	14.6	17.48
3	4	642.22	6,110	10.7	11.96

Table 3
Greek IPOs Classified by Listing Market (Main, Parallel, New)

The table presents means and medians for various characteristics of Greek IPOs by market classification. Specification (1) indicates underpricing measured by market adjusted underpricing (MAU); Specification (2) provides the *size*, which is expressed by the log of market capitalization and specification (3) the *age*, which describes the period between the year of company establishment and the year it goes public. Specification (4) depicts the *given ownership* which covers the proportion of sold ownership during the going public process. MAU calculates the level of underpricing by the time the unconstrained price will occur. The sample period is between January 1, 1990 and December 31, 2013 for Greek listed firms with mainly hand collected data.

	Listing Market	Number of IPOs	Underpricing (measured by MAU) (1)		Size (m €) (2)		Age (3)		Public Float Given Ownership (4)	
			mean	*median*	*mean*	*median*	*mean*	*median*	*mean*	*median*
Whole sample	Main	184	37.04	15	38,845	6,076	19.97	17	19.57	20
	Parallel	155	71.21	33.46	6,863	3,619	15.75	13	21.48	21.56
	New	12	54.54	13.93	4,965	3,762	13.15	11	17.16	15
	Total	351	52.63	22.52	23,427	4,933	17.86	14	21.69	20.96
No Price Cap	Main	95	37.45	6.60	55,288	7,777	19.82	15	19.48	20.07
	Parallel	85	50.63	21.93	9,521	7,420	16.1	14	17.36	16.61
	New	13	54.54	13.93	4,965	3,762	13.15	11	21.69	20.06
	Total	191	44.35	12.10	31,728	6,701	17.74	14	18.69	20
±8% Cap	Main	62	22.74	19.37	9,514	4.705	18.14	15.5	23.54	22.30
	Parallel	31	43.39	34.59	1,878	1,390	16.67	15	19.67	17.26
	Total	93	29.62	23.48	6,968	2,988	17.65	15	22.25	21.35
±99% Cap	Main	27	63.46	56.85	49,977	15,870	24.70	22	23.6	21.11
	Parallel	40	134.2	84.39	5,211	2,266	14.3	11	14.8	13.7
	Total	67	105.7	70.81	22,846	5,693	18.49	13	18.4	15.9

Table 4: Results of multivariate regression analysis of cross sectional variation in MAU as dependent variable for 351 IPOs listed on ASE over the 1990-2013 period end of 2nd, 3rd…11th day of trading for price cap period

The table presents in specification (1) the estimates of OLS regression where the dependent variable is the market adjusted underpricing which accounts for the returns of the following day(s) in case where IPO hits the upper/lower limit. Specification (2) presents the estimates of OLS regression where the independent variables PC8 (PC99), take the value of one if the IPO is listed in the period with a price constraint of ±8% (±99%), and zero otherwise. Specification (3) presents the estimates of OLS regression where the independent variable BB (bookbuilding) takes the value of one if the IPO is listed using the book-building mechanism, and zero if it is listed with the fixed offer price method. The sample period is between January 1, 1990 and December 31, 2013 for Greek listed firms with hand collected data. See Appendix A for definitions of the variables. All variables are winsorized at the 1% on both tails, with the exception of binary variables. Results have been corrected for Heteroskedasticity-robust clustered standard errors. Number in parentheses are p-values. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	MAU (1)	MAU (2)	MAU (3)	MAU (4)
Constant	21.45	78.57**	82.38**	84.74**
	(0.489)	(0.036)	(0.033)	(0.028)
LBC	-1.194	6.111	6.106	4.996
	(0.842)	(0.330)	(0.330)	(0.418)
AGE	4.954	7.130*	7.295*	6.572
	(0.199)	(0.068)	(0.063)	(0.106)
PRIV	-8.373	-7.206	-7.027	-4.396
	(0.513)	(0.565)	(0.578)	(0.742)
SIZE	-1.425	-5.895**	-6.084**	-5.768**
	(0.492)	(0.023)	(0.021)	(0.027)
OVER	0.290***	0.274***	0.283***	0.280***
	(0.000)	(0.000)	(0.000)	(0.000)
UR	-4.200	-2.722	-2.123	-1.896
	(0.500)	(0.656)	(0.728)	(0.756)
RET	1.016	0.983	1.142	1.049
	(0.234)	(0.242)	(0.200)	(0.235)
NUIPO	2.139	6.073	5.592	4.652
	(0.585)	(0.152)	(0.173)	(0.258)
GO	0.293	0.563*	0.578*	0.631**
	(0.276)	(0.064)	(0.059)	(0.041)
IND	13.02	11.51	11.62	11.84
	(0.115)	(0.160)	(0.156)	(0.147)
PC8		-24.92***	-26.68***	-30.38***
		(0.0006)	(0.001)	(0.001)
PC99			-6.491	-9.806
			(0.501)	(0.356)
BB				-9.993
				(0.341)
Adj R^2	350	350	350	350
Obs.	0.344	0.359	0.359	0.360

Table 5: Results of Multivariate Regression Analysis By Listing Board Classification

The table presents in specifications (1) and (2) the estimates of OLS regressions based on a sample of IPOs that were listed in the *main* market of the stock exchange and in specifications (3) and (4) on a sample of IPOs that were listed in the *parallel* market of the stock exchange where the dependent variable is the market adjusted underpricing (MAU) which accounts for the returns of the following day(s) in case where the IPO hits the upper/ lower limit. The sample period is between January 1, 1990 and December 31, 2013 for Greek listed firms with largely hand collected data. See Appendix A for definitions of the variables. All variables are winsorized at the 1% on both tails, with the exception of binary variables. Results have been corrected for Heteroskedasticity-robust clustered standard errors. Number in parentheses are p-values. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Variables	MAU (Main) (1)	MAU (Main) (2)	MAU (Parallel) (3)	MAU (Parallel) (4)
Constant	47.07	49.68	217.8**	217.9**
	(0.341)	(0.334)	(0.022)	(0.021)
AGE	1.524	3.301	-11.89	-11.94
	(0.723)	(0.436)	(0.432)	(0.421)
PRIV	-5.583	-11.49	8.432	8.508
	(0.716)	(0.429)	(0.711)	(0.709)
SIZE	-2.648	-3.607	-12.47*	-12.46*
	(0.434)	(0.304)	(0.058)	(0.056)
OVER	0.279***	0.297***	0.434***	0.434***
	(0.000)	(0.000)	(0.000)	(0.000)
UR	11.51	10.29	-20.44*	-20.47*
	(0.157)	(0.203)	(0.093)	(0.085)
RET	1.640	1.937*	-1.918	-1.928
	(0.104)	(0.051)	(0.298)	(0.299)
NUIPO	4.125	4.238	8.592	8.525
	(0.305)	(0.261)	(0.387)	(0.394)
GO	0.689	0.761	0.762	0.770
	(0.235)	(0.214)	(0.275)	(0.239)
IND	16.59*	15.30	27.23	27.21
	(0.093)	(0.130)	(0.125)	(0.123)
PC8	-34.49***	-29.18***	-28.54*	-28.70**
	(0.001)	(0.002)	(0.055)	(0.037)
BB	-20.25*		0.469	
	(0.075)		(0.971)	
Adj. R^2	0.280	0.267	0.446	0.449
Obs.	183	183	167	167

Table 6: Sample Partition by Regulatory Period

This table presents the results of multivariate regression analysis of cross sectional variation with MAU as dependent variable over the sample period between January 1, 1990 and December 31, 2013 for Greek listed firms with largely hand collected data. The table presents in specification (1) the results of IPOs that were listed without any price limit and in specification (2) the estimates of OLS regression on IPOs that were listed during the ±8% price limit period. Specification (3) looks at IPOs that went public without any price limit over the period Dec 1, 1999 till Dec 31, 2013. Specification (4) includes IPOs that were priced by the book-building method and investigates the price revision effect. See Appendix A for definitions of the variables. All variables are winsorized at the 1% on both tails, with the exception of binary variables. Results have been corrected for Heteroskedasticity-robust clustered standard errors. Number in parentheses are p-values. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

Variable	MAU (NoPL) (1)	MAU (PL8) (2)	MAU (NOPL post 1999) (3)	MAU (Book Building) (4)
Constant	154.9**	8.742	38.52	-112.7
	(0.010)	(0.840)	(0.528)	(0.146)
LBC	26.71***	-12.98	3.116	-15.55
	(0.004)	(0.136)	(0.807)	(0.221)
AGE	11.96*	5.233	1.337	-3.989
	(0.056)	(0.161)	(0.826)	(0.431)
PRIV	-12.21	-9.336	-12.73	-12.67
	(0.494)	(0.272)	(0.274)	(0.439)
SIZE	-14.00***	0.447	-6.383	4.318
	(0.002)	(0.888)	(0.163)	(0.295)
OVER	0.320***	0.200***	0.423***	1.347**
	(0.0001)	(0.000)	(0.001)	(0.033)
UR	-9.601	4.515	-9.704	13.03
	(0.326)	(0.403)	(0.371)	(0.418)
RET	1.350	-1.925	-0.565	1.282
	(0.202)	(0.206)	(0.749)	(0.610)
NUIPO	16.85**	-6.443*	13.04**	33.95*
	(0.010)	(0.076)	(0.044)	(0.071)
GO	1.584**	0.216	1.613**	0.377
	(0.018)	(0.374)	(0.023)	(0.330)
IND	17.01*	7.793	5.744	0.598
	(0.0788)	(0.468)	(0.580)	(0.968)
BB			9.21	-
			(0.228)	-
INAL			0.321	0.327
			(0.137)	(0.240)
PREV				0.592**
				(0.030)
Adj R^2	0.412	0.351	0.364	0.340
Obs	191	93	140	90

Table 7: Robustness and Auxiliary Tests (ALL IPOs)

This table reports the results of multivariate regression analysis of cross sectional variation with MAU as dependent variable for IPOs listed on ASE over the sample period between January 1, 1990 and December 31, 2013 for Greek listed firms with largely hand collected data. Specification (1) excludes the 7 outliers of the sample of Greek IPOs. Specification (2) excludes the 'Hot' 3rd and 4th quarters of 1999. Specification (3) includes only IPOs listed between 1990-1998. Specification (4) examines the period mid 1992-2013, excluding the 7 outliers of the sample of Greek IPOs. Specification (5) excludes the period 1990-mid 1992 and the 'Hot' 3rd and 4th quarters of 1999. See Appendix A for definitions of the variables. All variables are winsorized at the 1% on both tails, with the exception of binary variables. Results have been corrected for Heteroskedasticity-robust clustered standard errors. Number in parentheses are p-values. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	IPOs listed in the period 1990-2013			**IPOs listed in the post 1992 period**	
	MAU IPOs exclude outliers (1)	MAU Exclude 3rd & 4th Quarter 1999 (2)	MAU IPOs 1990-1998 (3)	MAU IPOs exc. outliers, (4)	MAU exc. 3rd and 4th Qrts of 1999 (5)
Constant	74.74**	95.34**	118.1*	32.94	55.10
	(0.047)	(0.013)	(0.085)	(0.331)	(0.103)
LBC	7.080	2.128	5.832	-1.916	-9.037
	(0.232)	(0.742)	(0.533)	(0.739)	(0.142)
AGE	2.887	4.338	6.586	-0.396	1.385
	(0.452)	(0.277)	(0.204)	(0.917)	(0.720)
PRIV	-5.702	-0.871	-4.338	-3.873	2.357
	(0.653)	(0.946)	(0.918)	(0.582)	(0.708)
SIZE	-4.822*	-5.948**	-6.952**	-1.783	-2.967
	(0.071)	(0.030)	(0.018)	(0.482)	(0.243)
OVER	0.248***	0.252***	0.186***	0.283***	0.287***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR	2.329	-2.077	2.981	4.162	-0.356
	(0.676)	(0.732)	(0.675)	(0.456)	(0.953)
RET	1.326	0.770	0.574	1.378	-0.582
	(0.124)	(0.399)	(0.580)	(0.247)	(0.610)
NUIPO	5.382**	5.499*	-1.028	-0.594	2.205
	(0.043)	(0.051)	(0.818)	(0.845)	(0.582)
GO	0.838*	0.487	0.126	0.857*	0.522*
	(0.073)	(0.131)	(0.762)	(0.075)	(0.063)
IND	10.12	9.024	17.00	4.225	3.393
	(0.171)	(0.229)	(0.145)	(0.572)	(0.645)
PC8	-25.79***	-26.35***	-21.03**	-13.25*	-12.95*
	(0.0009)	(0.001)	(0.033)	(0.069)	(0.086)
BB	-10.10	-9.897	12.30	-3.377	-4.018
	(0.200)	(0.214)	(0.701)	(0.674)	(0.632)
Obs.	343	329	178	296	282
Adj. R^2	0.294	0.291	0.158	0.371	0.364

Table 8: Robustness and Auxiliary Tests (Adjustment for industry specific shocks)

This table presents the results of multivariate regression analysis of cross sectional variation with MAUR as dependent variable for IPOs listed on ASE over the sample period between January 1, 1990 and December 31, 2013 for Greek listed firms with largely hand collected data. The dependent variable is a continuous variable controlling for industry effect. Specification (1) provides a generic cross sectional regression for the whole sample of Greek IPOs. Specification (2) includes the ±PC8 control variable in the regression. Specification (3) tests for book-building effect in addition to all others. Specification (4) includes only IPOs listed in the Main Market while specification (5) covers IPOs listed in the Parallel Market. See Appendix A for definitions of the variables. All independent variables are lagged with respect to the dependent variable. All variables are winsorized at the 1% on both tails, with the exception of binary variables. Results have been corrected for Heteroskedasticity-robust clustered standard errors. Number in parentheses are p-values. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

	MAUR All (1)	MAUR All (2)	MAUR All (3)	MAUR Main Market (4)	MAUR Parallel Market (5)
Constant	-89.01	-7.834	-11.60	110.3	-410.0
	(0.196)	(0.925)	(0.887)	(0.225)	(0.126)
LBC	18.04*	30.13**	29.60**	-	-
	(0.098)	(0.021)	(0.018)	-	-
AGE	2.566	4.354	0.310	9.965	-11.75
	(0.719)	(0.556)	(0.969)	(0.205)	(0.570)
SIZE	6.846	0.693	2.474	-4.527	29.46*
	(0.158)	(0.907)	(0.676)	(0.467)	(0.098)
OVER	0.165*	0.150*	0.142	-0.049	0.355**
	(0.060)	(0.097)	(0.117)	(0.346)	(0.011)
UR	-0.858	1.801	1.612	7.422	10.19
	(0.945)	(0.885)	(0.896)	(0.598)	(0.563)
RET	0.531	0.452	0.442	1.197	-6.097*
	(0.816)	(0.825)	(0.821)	(0.504)	(0.073)
NUIPO	15.63**	19.82***	17.39***	15.93**	0.101
	(0.016)	(0.001)	(0.007)	(0.043)	(0.996)
GO	-1.815**	-1.395**	-1.558**	-0.909	-0.867
	(0.020)	(0.042)	(0.024)	(0.182)	(0.698)
PC8		-30.65**	-33.83**	-50.32***	19.98
		(0.027)	(0.015)	(0.004)	(0.316)
BB			-31.77**	-34.66*	-12.91
			(0.016)	(0.085)	(0.499)
Adj R^2	0.208	0.234	0.249	0.111	0.560
Obs.	102	102	102	60	42

Figure 1: Implementation of regulatory price limits on IPOs launched on A.S.E. during 1990-2013 period

The sample is divided into four periods. The first period, January 1, 1990 and June 30, 1992 is characterised by trading without any limits. In July 1992 the stock exchange imposed price limits of ±8% which remained until November 30, 1996. In December 1, 1996, the price limits were expanded to ±99% during the first 3 days of trading of IPO stocks and remained in force until November 30, 1999. Finally on December 1, 1999 price limits were removed and early trading took place without limits.